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Integrated Pest Management Decision Key



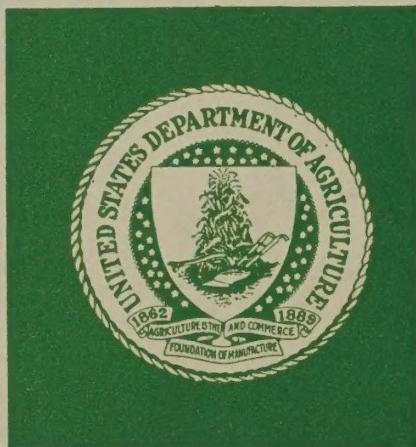
United States Department of Agriculture - Forest Service

State & Private Forestry - Southeastern Area
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MAJOR INSECTS AND DISEASES OF SOUTHERN FORESTS

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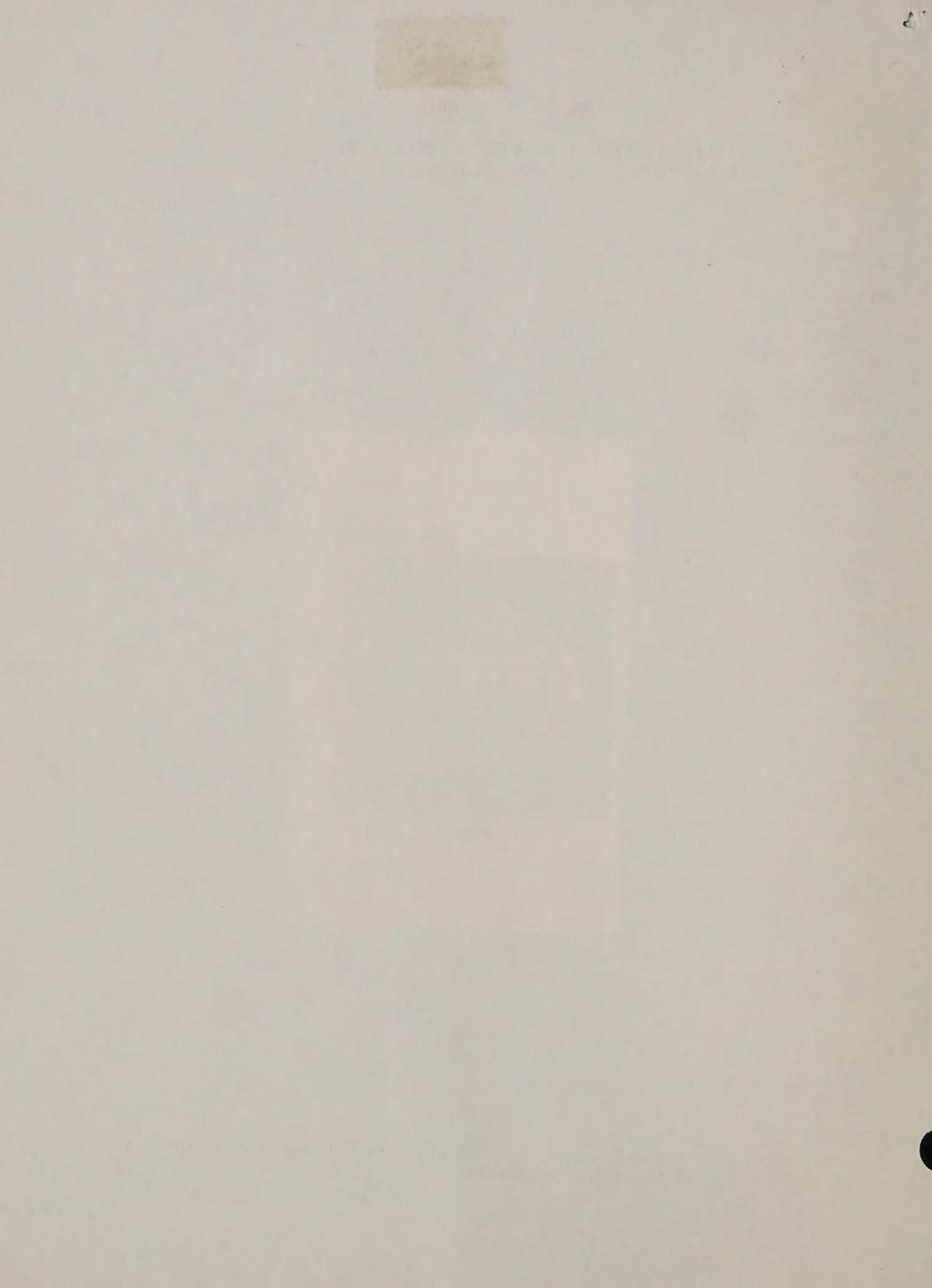
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1/ Additional chapters will become available in the future. Each chapter will coincide with one of the major categories.



INTEGRATED PEST MANAGEMENT DECISION KEY FOR
MAJOR INSECTS AND DISEASES OF SOUTHERN FORESTS:

GENERAL INFORMATION

CHAPTER 1
Version 1-1

USER'S MANUAL

USDA Forest Service
Southeastern Area, State and Private Forestry
Atlanta, GA 30367

INTEGRATED PEST MANAGEMENT DECISION KEY FOR
MAJOR INSECTS AND DISEASES OF SOUTHERN FORESTS:

GENERAL INFORMATION

Developed by:

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INTRODUCTION

For centuries, forest land managers have used a variety of preventative and direct control options to deal with forest pests. Only recently have we begun to speak of this concept as "IPM" or "Integrated Pest Management." "IPM" is defined and explained as:

"A process in which all aspects of a pest-host system are studied and weighed to provide the resource manager with information for decision-making. Integrated pest management is, therefore, a part of the forest or resource management. The information provided includes the impact of the unregulated pest population on various resources values, alternative regulatory tactics and strategies, and benefit-cost estimates for these alternative strategies. Regulatory strategies are based on sound silvicultural practices and ecology of the pest-host system. Strategies consist of a combination of tactics, such as stand improvement plus selected use of pesticides. The overriding principle in the choice of strategy is that it is ecologically compatible or acceptable."^{1/}

In other words, it is the use of a variety of detection, evaluation, prevention, and direct control techniques to protect trees.

These environmental concerns, as well as an obvious need to produce more quality timber in a shorter time period on a declining land base, encourage us to approach this concept in a systematic manner.

In recent years, we have seen many new recommendations and approaches to forest insect and disease management. In some cases, control and prevention recommendations for one pest may conflict with those for another (e.g., drainage of wet areas to discourage southern pine beetle build-up may increase susceptibility of the stand to annosus root rot during subsequent thinning). This integrated pest management key has been developed to help resolve these conflicts and provide the resource manager with the latest recommended stand management options in an easily understood system.

^{1/} Source: Federal Register, Vol. 44, No. 181, September 17, 1979.

HOW THE KEY IS MAINTAINED AND REVISED

A committee has been created to maintain and revise the key for each chapter; e.g., Major Insects and Diseases of Southern Pines. The appointed individuals are listed in the appropriate chapter.

Questions concerning the program should be directed to Robert J. Uhler. Questions concerning silviculture, pathology, and entomology should be directed to the appropriate specialist. Proposals to revise the Key should be submitted in writing to the coordinator, H. Daniel Brown, USDA Forest Service, S&PF, Forest Pest Mgmt., 1720 Peachtree St., N.W., Room 710, Atlanta, Ga. 30367.

The committees will meet on an "as needed" basis to consider the proposed revision. As the revisions are made, the version number will change. The users should make sure they have the most current version as indicated at the start of the printout for the Key.

GENERAL INFORMATION

IPM-DK (Integrated Pest Management Decision Key) is an interactive computer program which is based on variables in common use in forestry. It offers land managers suppression and preventative strategies for a variety of pests under several different management strategies; e.g., major insects and diseases of southern pines. This program requires no user fee and can be reached by calling the Apple computer of the USDA Forest Service's Forest Pest Management staff at Doraville, Ga. (commercial number - 404/221-5200 or FTS number 242-5200). However, the user must have an interactive terminal. The terminal must be set at 30 characters per second (300 baud) and at full duplex.

Upon contacting the computer, the following will occur:

1. You will be asked to tap a carriage return.
2. You will be asked to type your name (8 or more characters).
3. The "menu", a list of available programs, is displayed. Simply type in the corresponding number for the IPM-DK and tap the carriage return key.

INPUTS

Upon answering the above questions, you will be in the IPM-DK program. The IPM-DK program will ask questions about the site and stand conditions for which you want a pest recommendation. All of the questions are answered with a one character answer except for the recommendation numbers, which are two character numbers. No carriage return is necessary to terminate an answer.

All questions are answered with a one character response such as:

1. Y-Yes
2. N-No
3. B-(backup) allows the user to have the last question asked again.
4. E-(exit) allows the user to start over or to terminate the session.
5. R-allows the user to print a complete recommendation.
6. D-allows the user to print a list of all recommendations.
7. nn-is a two digit recommendation code.

All questions are prefixed by a Q and a four digit number; for example, 00120. The user can use this prefix to index into the narrative used in each of the chapters.

INTEGRATED PEST MANAGEMENT DECISION KEY FOR
MAJOR INSECTS AND DISEASES OF SOUTHERN FORESTS:

SOUTHERN PINE BEETLE, FUSIFORM RUST, ANNOSUS
ROOT ROT, AND LITTLELEAF ON SLASH, LOBLOLLY,
AND SHORTLEAF PINES

CHAPTER 2
Version 2-1

USER'S MANUAL

USDA Forest Service
Southeastern Area, State and Private Forestry
Atlanta, GA 30367



INTEGRATED PEST MANAGEMENT DECISION KEY FOR
MAJOR INSECTS AND DISEASES OF SOUTHERN FORESTS:

SOUTHERN PINE BEETLE, FUSIFORM RUST, ANNOSUS
ROOT ROT, AND LITTLELEAF ON SLASH, LOBLOLLY,
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Developed by:

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Robert J. Uhler
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Much of the southern pine beetle information in this Decision Key is based on research supported through the Expanded Southern Pine Beetle Research and Applications Program (ESPBRAP).

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INTEGRATED PEST MANAGEMENT DECISION KEY FOR MAJOR INSECTS AND DISEASES OF SOUTHERN FORESTS:

SOUTHERN PINE BEETLE, FUSIFORM RUST, ANNOSUS
ROOT ROT, AND LITTLELEAF ON SLASH, LOBLOLLY,
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HOW THE KEY IS MAINTAINED AND REVISED

The following people are serving on a committee to maintain and revise this chapter:

H. Daniel Brown, Coordinator 404-881-2961, FTS 257-2961
R. L. Anderson, Pathologist 704-258-2850, ext. 625, FTS 672-0625
R. P. Belanger, Silviculturist 404-546-2422, FTS 250-2422
W. H. Hoffard, Entomologist 704-258-2850, ext. 625, FTS 672-0625
P. Mistretta, Pathologist 318-473-7280, FTS 497-7280
R. J. Uhler, Computer Specialist 404-221-4796, FTS 242-4796

Questions concerning the program should be directed to Robert J. Uhler. Questions concerning silviculture pathology, and entomology should be directed to the appropriate specialist. Proposals to revise the Key should be submitted in writing to the Coordinator, H. Daniel Brown, USDA Forest Service, S&PF, Forest Pest Mgmt., 1720 Peachtree St., N.W., Room 710, Atlanta, Ga. 30367.

The committees will meet on an "as needed" basis to consider the proposed revision. As the revisions are made, the version number will change. The users should make sure they have the most current version as indicated at the start of the printout for the Key.

DATA NEEDED TO RUN PROGRAM

1. Management Objectives ^{1/}	<hr/>		
2. Pest to be Considered	Yes		
Southern Pine Beetle	<input type="checkbox"/>		
Fusiform	<input type="checkbox"/>	(check one or more)	
Annosus Root Rot	<input type="checkbox"/>		
Littleleaf	<input type="checkbox"/>		
3. Type of Area			
Forest Stand	<input type="checkbox"/>		
Seed Orchard	<input type="checkbox"/>		
Shade Trees	<input type="checkbox"/>	(check only one)	
Nurseries	<input type="checkbox"/>		
Other Areas	<input type="checkbox"/>		
4. Stand Status	Area to be regenerated	<input type="checkbox"/>	
	Natural?	<input type="checkbox"/>	
	Planted?	<input type="checkbox"/>	
2 inches or less	<input type="checkbox"/>		
2 inches to mature	<input type="checkbox"/>		
Overmature	<input type="checkbox"/>		
5. Hazard Rating (See tables 1, 2, and 3)	High	Low	
Southern Pine Beetle	<input type="checkbox"/>	<input type="checkbox"/>	
Fusiform	<input type="checkbox"/>	<input type="checkbox"/>	(check one or more)
Annosus Root Rot	<input type="checkbox"/>	<input type="checkbox"/>	
Littleleaf	<input type="checkbox"/>	<input type="checkbox"/>	
6. Fusiform Infection in Current Stand or Adjacent Stand			
Estimate % fusiform	<input type="checkbox"/>		
7. Geographic Location			
Coastal	<input type="checkbox"/>		
Piedmont	<input type="checkbox"/>	(check only one)	
Mountains	<input type="checkbox"/>		
8. Annosus Root Rot (Trees off-color, thin crowns, tufted foliage, and/or fruiting bodies)			
Present	<input type="checkbox"/>		
Absent	<input type="checkbox"/>	(check only one)	
9. # Fusiform-free Trees/Acre for Stands 2 Inches and Less	<input type="checkbox"/>		

^{1/} Such as pulpwood, solid wood products, wildlife, etc.

INPUTS

Upon contacting the computer and answering three questions (see Chapter 1), you will be in the IPM-DK program. The IPM-DK program will ask questions about the site and stand conditions for which you want a pest recommendation. All of the questions are answered with a one character answer. No carriage return is necessary to terminate an answer.

All questions are answered with a one character response such as:

1. Y-Yes
2. N-No
3. B-(backup) allows the user to have the last question asked again.
4. E-(exit) allows the user to start over or to terminate the session.
5. R-allows the user to print a complete recommendation.
6. D-allows the user to print a list of all recommendations.
7. nn-is a two digit recommendation code.

All questions are prefixed by a Q and a four digit number; for example, Q0120. The user can use this prefix to index into the narrative used in each of the chapters.

Q0000 DO YOU WANT AN INTRODUCTION?

If you enter a "Y", a description of the key will be printed.

Q0010 DO YOU WANT TO CONSIDER SOUTHERN PINE BEETLE?
Q0020 DO YOU WANT TO CONSIDER FUSIFORM RUST?
Q0030 DO YOU WANT TO CONSIDER ANNOSUS ROOT ROT?
Q0040 DO YOU WANT TO CONSIDER LITTLELEAF?

The user enters a "Y" if the particular pest is to be considered and an "N" if it is not. At least one of the four questions (Q0010-Q0040) must be answered "yes."

Q0050 IS THIS MANAGEMENT UNIT A FOREST STAND?
Q0060 IS THIS MANAGEMENT UNIT A SEED ORCHARD?
Q0070 IS THIS MANAGEMENT UNIT A SHADE TREE?
Q0080 IS THIS MANAGEMENT UNIT A NURSERY?
Q0090 IS THIS MANAGEMENT UNIT ANOTHER TYPE OF AREA?

Only one of the above five questions, Q0050-Q0090, may be answered "yes." IPM-DK asks question Q0050 first. If the answer is "no", it asks question Q0060. IPM-DK will keep asking each question, Q0050-Q0090, until it receives a "yes."

Q0100 IS THE SITE TO BE REGENERATED WITHIN 10 YEARS?
Q0110 IS THE D.B.H. IN THIS STAND LESS THAN 2 INCHES?
Q0120 IS THE D.B.H. IN THIS STAND GREATER THAN 2 INCHES BUT NOT OVER-MATURE?
Q0130 IS THE STAND OVERMATURE?

Only one of the above four questions, Q0100-Q0130, may be answered yes. IPM-DK asks question Q0100 first. If the answer is "no", it asks question Q0110. IPM-DK will keep asking each question, Q0100-Q0130, until it receives a "yes." The definition of overmature is left up to the resource manager.

Q0142 ARE CONDITIONS HIGH HAZARD FOR SOUTHERN PINE BEETLE?

Q0144 ARE CONDITIONS HIGH HAZARD FOR FUSIFORM?

Q0146 ARE CONDITIONS HIGH HAZARD FOR ANNOSUS ROOT ROT?

Q0148 ARE CONDITIONS HIGH HAZARD FOR LITTLELEAF?

The user should use table 1, 2, or 3 in the appendix or a local hazard rating system to answer questions, Q0142-Q0148.

Q0150 IS MORE THAN 50 PERCENT OF THE SITE OR ADJACENT STANDS INFECTED WITH FUSIFORM?

This question will be asked only if fusiform rust was chosen as a pest. Infected trees are defined as main stem cankers or galls within 12 inches of the main stem.

Q0160 IS THIS MANAGEMENT UNIT IN THE COASTAL PLAIN?

Q0170 IS THIS MANAGEMENT UNIT IN THE PIEDMONT?

Q0180 IS THIS MANAGEMENT UNIT IN THE MOUNTAINS?

Only one of the above three questions, Q0160-Q0180, may be answered "yes." IPM-DK asks question Q0160 first. If the answer is "no", it asks question Q0170. IPM-DK will keep asking each question, Q0160-Q0180, until it receives a "yes."

Q0190 IS THE SITE ADEQUATELY STOCKED?

The user should use some local stocking table or table 4 in the appendix to answer this question.

Q0195 IS THE SITE OVERSTOCKED?

The user should use some local stocking table or table 4 in the appendix to answer this question.

Q0200 DO YOU WANT MORE INFORMATION ON A PARTICULAR RECOMMENDATION?

If you want more information about a recommendation, answer with a "Y." However, if you do not want more information, answer "N."

Q0220 IS ANNOSUS ROOT ROT PRESENT?

If annosus root rot is present, answer "Y."

Q0230 ENTER A TWO DIGIT RECOMMENDATION NUMBER; FOR EXAMPLE, ENTER A "23" FOR "R23", OR AN "E", "B", OR "D."

If you want more information about a recommendation, type in the two digit code preceding the recommendation; e.g., 12 for R12. Use protective chemical treatments when economical. You can also hit an "E" to exit the session or a "B" to backup to the last question. A "D" will enable you to print a list of all recommendations.

00240 ENTER A ONE CHARACTER PEST CODE; THAT IS, S=SPB, F=FUSIFORM,
A=ANNOSUS, OR L=LITTLELEAF

Q0250 IS THE AREA IN THE PIEDMONT OR MOUNTAINS?

If the site is in the coastal plain, then the user should respond with an "N." However, if the site is either in the piedmont or in the mountains, then the answer to Q0250 should be a "Y."

Q0260 IS THE AREA TO BE NATURALLY REGENERATED AS OPPOSED TO PLANTED?

If the area is to be regenerated by planting, then Q0260 should be answered "N." However, if a natural regeneration is planned, then Q0260 should be answered "Y."

Q0999 DO YOU WANT TO PROCESS ANOTHER MANAGEMENT UNIT?

If the answer is "N", then the user exits the IPM-DK program. The user can have the menu of programs displayed or can sign-off. However, if the answer is "Y", the IPM-DK program starts over in order to analyze another management unit.



EXAMPLE RUN

The following is an example run, in which all four pests are considered.

Enter a Carriage Return.

Date: 09/08/81

Time: 09:38:30 EDT

Please enter your name ? John Doe

Would you like to see the menu (Yes or No)? N

Enter the program number? 14

*** You can return to the menu at any time by entering a Control-C followed by a Carriage Return ***

Control-C = The C key is struck while the Control Key is held down.

Q0000 DO YOU WANT AN INTRODUCTION? Y

The IPM Decision Key is an interactive program which lists management options for southern pine beetle, fusiform rust, annosus root rot, and littleleaf disease. The program considers a variety of environmental, geographic, economic, and management factors. Pest and pest management interaction is also considered. The user should have the IPM-DK User's Manual (Version 2-1), which clarifies and elaborates on the output. Copies are available from:

IPM-DK Coordinator
USDA Forest Service
S&PF, Forest Pest Management
1720 Peachtree St., N.W.
Atlanta, GA 30367

Telephone: 404-881-2961

All questions are answered with a one character response, such as:

1. Y - Yes
2. N - No
3. B - B (backup) allows the user to have the last question asked again.
4. E - E (exit) allows the user to start over or to terminate the session.
5. R - allows the user to print a complete recommendation.
6. D - allows the user to print a list of all recommendations.

**** VERY IMPORTANT ****

An answer consists of only one character and is not terminated by a Carriage Return as in most interactive programs. Entering a Carriage Return will cause an error statement to be written.

Q0010 DO YOU WANT TO CONSIDER SOUTHERN PINE BEETLE? D

All possible recommendations:

- R00 Normal management.
- R11 When available, use seed or seedlings which are resistant to the pest.
- R12 Use protective chemical treatments when economical.
- R13 Cull seedlings with fusiform swellings on the stem.
- R14 Reduce oak population when practical and when not in conflict with other management practices.
- R15 Modify fertilization practices.
- R16 Prune and excise fusiform galls and cankers.
- R17 Consider thinning or salvage cutting.
- R18 Consider altering planting density.
- R19 Consider seed tree or shelterwood regeneration.
- R20 Consider subsoiling.
- R21 Consider prescribed burning.
- R22 Perform frequent surveillances.
- R23 Treat stumps with phlebia gigantea.
- R24 Treat with borax or thin during summer (May-August) south of 34 degrees north latitude.
- R25 Consider irrigation.
- R26 Control active infestations.
- R27 Remove high risk trees.
- R28 Minimize site disturbance.
- R29 Avoid damage to trees.
- R30 Manage species composition.
- R31 Regulate age classes.
- R32 Drain wet sites.
- R33 Avoid damage to low-lying areas.
- R34 Intensify management on good sites.
- R35 Harvest at age 25.

Q0010 DO YOU WANT TO CONSIDER SOUTHERN PINE BEETLE? R

Q0020 DO YOU WANT MORE INFORMATION ON A PARTICULAR RECOMMENDATION? 1

Illegal quantity...All entries must be either a Y=Yes, N=No, B=Backup, E=Exit, D=Display...Try again.

Q0020 DO YOU WANT MORE INFORMATION ON A PARTICULAR RECOMMENDATION? Y

Q0230 ENTER A TWO DIGIT RECOMMENDATION NUMBER; I.E., A 23 for R23, or an E, B, or D? 11

Q0240 ENTER A 1 CHARACTER PEST CODE; I.E., S=SPB, F=FUSIFORM, A=ANNOSUS, OR L=LITTLELEAF? F

R11 When available, use seed or seedlings which are resistant to the pest.

-Fusiform rust- Loblolly, slash only

When possible, avoid planting rust-susceptible pines on high-hazard sites (use Table 2 in the User's Manual). Regeneration of high-hazard sites should be done with seeds or seedlings from:

Rust resistant slash and loblolly pine seed orchards, or
Geographic areas of resistance; e.g., Livingston Parish, La., East Texas,
Maryland, Arkansas, etc., or a mixture of these. Use resistant local
sources when possible.

Q0230 ENTER A TWO DIGIT RECOMMENDATION NUMBER; I.E., ENTER A 23 for R23, OR AN
E, B, OR D? E

Q0999 DO YOU WANT TO PROCESS ANOTHER SITE? Y

Q0010 DO YOU WANT TO CONSIDER SOUTHERN PINE BEETLE? Y

Q0020 DO YOU WANT TO CONSIDER FUSIFORM RUST? Y

Q0030 DO YOU WANT TO CONSIDER ANNOSUS ROOT ROT? Y

Q0040 DO YOU WANT TO CONSIDER LITTLELEAF? Y

Q0050 IS THIS MANAGEMENT UNIT A FOREST STAND? N

Q0060 IS THIS MANAGEMENT UNIT A SEED ORCHARD? N

Q0070 IS THIS MANAGEMENT UNIT A SHADE TREE? N

Q0080 IS THIS MANAGEMENT UNIT A NURSERY? N

Q0090 IS THIS MANAGEMENT UNIT ANOTHER TYPE OF AREA? N

One of the last 5 questions has to be answered Yes...Try again...

Q0050 IS THIS MANAGEMENT UNIT A FOREST STAND? Y

Q0100 IS THIS AREA TO BE REGENERATED WITHIN THE NEXT 10 YEARS? N

Q0110 IS THE DBH IN THIS AREA LESS THAN 2 INCHES? N

Q0120 IS THE DBH IN THIS AREA GREATER THAN 2 INCHES, BUT NOT OVERMATURE? Y

Q0142 ARE CONDITIONS HIGH-HAZARD FOR SOUTHERN PINE BEETLE? Y

Q0160 IS THIS MANAGEMENT UNIT IN THE COASTAL PLAIN? Y

Q0220 IS ANNOSUS ROOT ROT PRESENT? Y

Southern pine beetle- Loblolly, slash, shortleaf only

- R17 Consider thinning or salvage cutting.
- R22 Perform frequent surveillances.
- R23 Treat stumps with phlebia gigantea.
- R26 Control active infestations.
- R27 Remove high risk trees.

- R28 Minimize site disturbance.
- R29 Avoid damage to trees.
- R30 Manage species composition.
- R33 Avoid damage to low-lying areas.
- R34 Intensify management on good sites.

Fusiform rust- Loblolly, slash only

- R14 Reduce oak population when practical and when not in conflict with other management practices.
- R15 Modify fertilization practices.
- R17 Consider thinning or salvage cutting.
- R21 Consider prescribed burning.
- R23 Treat stumps with phlebia gigantea.
- R27 Remove high risk trees.

Annosus root rot- Loblolly, slash, shortleaf only

- R17 Consider thinning or salvage cutting.
- R21 Consider prescribed burning.
- R22 Perform frequent surveillances.
- R23 Treat stumps with phlebia gigantea.

Littleleaf- Loblolly, shortleaf only

- ROO Normal management.

Q0200 DO YOU WANT MORE INFORMATION ON A PARTICULAR RECOMMENDATION? Y

Q0230 ENTER A TWO DIGIT RECOMMENDATION NUMBER; I.E., ENTER A 23 for R23, OR AN E, B, OR D? 17

Q0240 ENTER A 1 CHARACTER PEST CODE; I.E., S=SPB, F=FUSIFORM, A=ANNOSUS, OR L=LITTLELEAF? S

R17 Consider thinning or salvage cutting.

- Southern pine beetle- Loblolly, slash, shortleaf only

High risk stands are characterized by slow radial growth. Thinning is a means of promoting and maintaining rapid growth of young stands and reducing losses from the SPB.

Low thinning or "thinning from below" is recommended to reduce competition and remove slow-growing trees, which are most subject to SPB attacks. The poorer crown classes--suppressed and intermediate trees--are cut first. Dominant and co-dominant trees with large live crown ratios and desirable phenotypic traits should be favored as crop trees. They are most likely to respond to thinning and to provide the greatest number of silvicultural options in the management of residual stands.

Degree of thinning is determined by the intensity of management, the kind of product desired, available markets, and natural conditions particular to each location. Depending on site quality, basal areas of 80 to 100

square feet/acre are recommended to reduce the potential for SPB attacks. The risk of beetle attack in most instances will increase considerably when stocking levels exceed 100 square feet/acre. Wide spacings distribute growth on fewer stems, resulting in the production of small sawlogs by age 35 to 40 years on good sites. Close spacings are recommended for high yields of wood fiber. Thinnings should be scheduled as needed to maintain desired stocking levels and stand vigor.

Thinning on high-hazard annosus root rot sites (> 70 percent sand in top-soil) can lead to severe infection followed by a reduction in radial growth and attack by SPB. Precautions can be taken to reduce the danger of annosus infection. Thinning should be scheduled during summer, when fewer annosus spores are produced and high temperatures kill those that are produced. Treating stumps in non-infected stands with borax reduces infection potential. Infected stands should be treated with phlebia gigantea. Prescribed burning before and after thinning also reduces severity of annosus root rot in the South.

Q0230 ENTER A TWO DIGIT RECOMMENDATION NUMBER; I.E., ENTER A 23 FOR R23, OR AN E, B, OR D? B

Q0200 DO YOU WANT MORE INFORMATION ON A PARTICULAR RECOMMENDATION? N

Q0999 DO YOU WANT TO PROCESS ANOTHER MANAGEMENT UNIT? N

Q0140 DO YOU WANT TO SIGN OFF? Y

Suggested Additional Reading

- Anderson, R. L., H. R. Powers, Jr., and G. A. Snow. 1980. How to identify fusiform rust and what to do about it. U.S. Dept. Agric. For. Serv., S&PF, Southeast. Area, Atlanta. Bull. SA-FB/P24. 12 p.
- Belanger, Roger P. and B. F. Malac. 1980. Silviculture can reduce losses from the southern pine beetle. USDA Combined Forest Pest Research and Development Program. Ag. Handbook No. 576. 17 p.
- Campbell, W. A. and O. L. Copeland. 1954. Littleleaf disease of shortleaf and loblolly pines. U.S. Dept. Agric., Circ. 940. 41 p.
- Dinus, R. J. and R. A. Schmidt, eds. 1977. Management of fusiform rust in southern pines. Symp. Proc. Univ. Fla., Gainesville. 163 p.
- Froelich, R. L., E. G. Kuhlman, C. S. Hodges, M. J. Weiss, and J. D. Nichols. 1977. *Fomes annosus* root rot in the South. Guidelines for prevention. U.S. Dept. Agric., For. Serv., S&PF, Southeast. Area, Atlanta. Publication SA S&PF-4. 17 p.
- Matthews, F. R. and R. L. Anderson. 1979. How to save your fusiform rust infected pines by removing cankers. U.S. Dept. Agric. For. Serv., S&PF, Southeast Area, Atlanta. Bull. SA-FB/P27. 6 p.
- Thatcher, Robert C., Janet L. Searcy, Jack E. Coster, and Gerald D. Hertel (Eds.) The southern pine beetle. USDA Expanded Southern Pine Beetle Research and Applications Program. U.S. Dept. Agric., For. Serv., Sci. and Ed. Adm. Tech. Bull. 1631.

APPENDIX

Table 1--Definition of high-hazard sites for southern pine beetle.^{1/}

GENERAL INFORMATION BASED ON RESEARCH IN THE EAST

- Coastal Plain: Poorly drained soils; low-lying landforms (wetlands, flood plain, stream terraces).
Deep, sandy high-hazard annosus sites are also high-hazard.
- Piedmont: Shallow "A" horizons; red clay throughout the soil profile; evidence of erosion.
- Mountains: Dry, south-facing slopes.

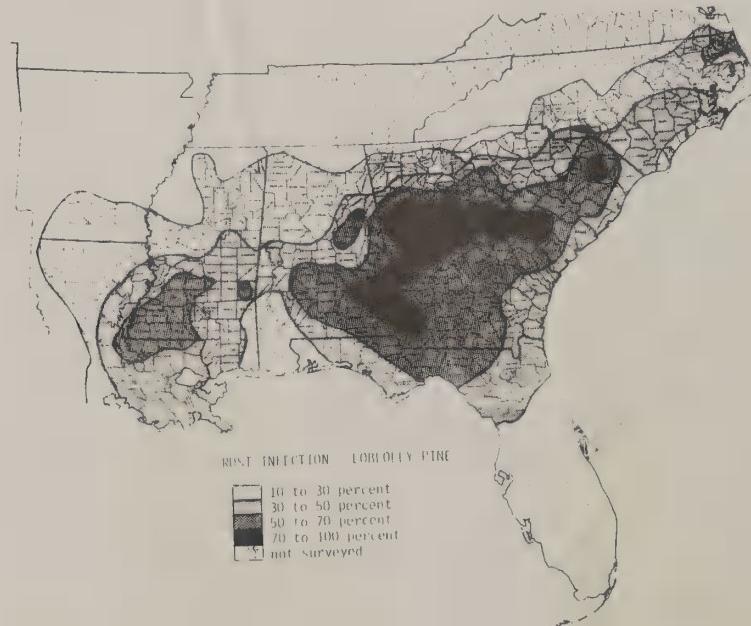
SPECIFIC INFORMATION FOR GEOGRAPHIC AREAS AS INDICATED

- East Texas and Louisiana: Loblolly or shortleaf pine stand (pine basal area $> 100 \text{ ft}^2/\text{A}$); average total tree height > 75 feet; evidence of SPB and/or annosus root rot; stand topographic position on low-lying landforms.
- Mississippi and Alabama: Loblolly or shortleaf pine stands ($> 80\%$ total pine); stand of large pole timber to sawtimber size (average d.b.h. > 9.6 in.); dense stocking (basal area, pine and hardwood, $> 120 \text{ ft}^2/\text{A}$); evidence of SPB and/or annosus root rot; topographic position of stand on ridge or upper slope.
- Georgia, South Carolina, North Carolina, and Virginia: Dense stocking (basal area, pine and hardwood, $> 120 \text{ ft}^2/\text{A}$); predominantly ($> 70\%$ pine); slow radial growth ($< 1/2$ -inch last 5 years); evidence of SPB and/or annosus root rot. High hazard for littleleaf disease; poor site conditions (clay soils, wet sites, low-lying landforms).

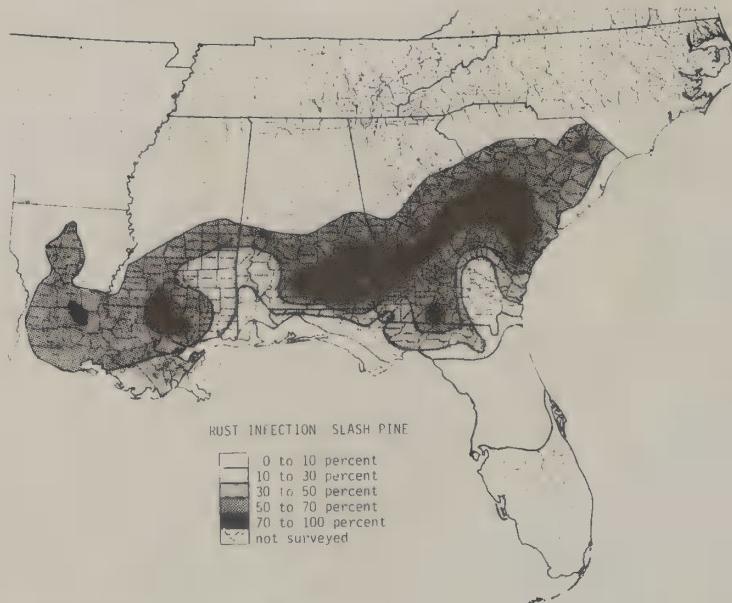
1/ Other risk rating systems may be available for specific states or areas of the South. The reader is encouraged to use whichever system he is comfortable with.

Table 2--Fusiform rust infection zones for loblolly and slash pine plantations and definition for high-hazard annosus root rot areas. Managers are encouraged to use their own system for fusiform rust hazard rating, but generally 50% or higher is considered high hazard.

FUSIFORM ZONES:



Map 1.—Infection zones for loblolly pine plantations.



Map 2.—Infection zones for slash pine plantations.

DEFINITION FOR HIGH HAZARD ANNOSUS ROOT ROT:

Sites having soils with sandy loam textures to a depth of 12 inches or more without poor internal drainage or high seasonal water table.

Table 3--A site with no previous history of littleleaf is a low-hazard site.
 Sites with a history of littleleaf are high-hazard.

A more detailed site hazard-rating method based on soil characteristics is presented by Campbell and Copeland (1954). This method is designed for field use and is useful when there is not a stand of shortleaf pine on site to evaluate. High-hazard soils score 0-50 points, moderate-hazard 51-74 points, and low-hazard 75-100 points.

Soil Character and Class

Erosion:

Slight - "A" horizon not seriously changed, more than 25 percent of "A" horizon removed.....	40
Moderate - 25-75 percent of "A" horizon lost, shallow gullies may be present.....	30
Severe - All of "A" horizon lost, often some of "B" gone, shallow gullies common.....	20
Rough gullied land - Soil profile has been destroyed, except in small areas between gullies.....	10

Subsoil Consistency (when moist):

Very friable - Crushes under gentle pressure, coheres when pressed...	32
Friable - Crushes under gentle to moderate pressure, coheres when pressed.....	24
Firm - Crushes with moderate pressure, but resists.....	16
Very firm - Crushes under strong pressure; barely crushes between thumb and forefinger.....	8
Extremely firm - Cannot be crushed between thumb and forefinger.....	0

Depth to zone of greatly reduced permeability:

24-36 inches (61-90 cms).....	15
18-23 inches (46-60 cm).....	12
12-17 inches (30-45 cm).....	9
6-11 inches (15-29 cm).....	3

Table 3--Con't

Subsoil mottling (greys and browns):

None.....	13
Slight.....	9
Moderate.....	5
Strong.....	1

See figure 1 for more detail.

Table 4--Adequate marginal and inadequate stocking for loblolly, slash, and shortleaf pine saplings and merchantable stands.¹²

Degree of Stocking	Sapling stands
	(Number rust-free stems per acre)
Adequate	300+
Marginal	151-299
Inadequate	151

1 Consideration of the number of rust-free stems and stocking level and the average height and diameter of the plantation are essential in making management decisions. This table should be of assistance when deciding when fusiform rust, coupled with other factors, has reduced stocking to an unacceptable level.

2 Plantations should be surveyed at age 3-5.

Table 5--The susceptibility of pines to SPB attack for major geographic regions of the South.

Levels of susceptibility	Geographic Region		
	Coastal Plain	Piedmont	Southern Appalachian
Most resistant	Slash Longleaf	Virginia Loblolly	Virginia Eastern white
Most susceptible	Shortleaf Loblolly	Shortleaf	Shortleaf Pitch



Fig. 1--Known distribution of littleleaf disease.



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Southern Pine Beetle Fact Sheet Number 3

SETTING CONTROL PRIORITIES

FOR THE SOUTHERN PINE BEETLE*

All southern pine beetle spots (groups of infested trees) do not have the same control priority. The following guidelines should help you set priorities for controlling individual spots.

A. Classify the infested trees according to the stage of attack shown below.

Symptom	Stage 1 Fresh attacks	Stage 2 Developing broods	Stage 3 Vacated trees
Foliage	Green	Green, trees with larvae; fade to yellow before new generation.	Red, needles falling.
Pitch tubes	Soft white, light pink,	White, hardened.	Hard, yellow, crumbles easily.
Checkered beetles	Adults crawl on the bark.	Larvae in SPB galleries; pink or red; 1/2 inch long.	Larvae and pupae are purple; occur in pockets in the outer bark.
Bark	Tight, hard to remove.	Loose, peels easily.	Very loose, easily removed.
Color of wood surface	White, except close to new adult galleries.	Light brown with blue or black sections.	Dark brown to black, may have sawyer galleries.
Exit holes	----	May appear where parent beetles left the tree.	Numerous
Ambrosia beetle dust	----	White, begins to appear around the base of trees.	Abundant at the base of trees.

*Compiled from a handbook of the Texas Forest Service. It will be published this fall by the USDA's Expanded Southern Pine Beetle Research and Applications Program.

B. Collect spot expansion data:

1. Walk completely around the spot and look for stage 1 trees, which indicate the area of most recent beetle activity. Areas with stage 1 pines are called "Active heads." Check to see if the spot is expanding in more than one direction. Large spots can have more than one active head.
2. Determine the number of stage 1 and 2 trees. For large spots that have more than 50 trees, it is not necessary to examine each tree. Just walk the boundaries and estimate the number of these trees in the spot.
3. From a location about 20 feet (6 m) in front of the active head(s), determine the pine basal area (a measure of stand density) in square feet per acre. A 10-factor prism is useful for this purpose.
4. Note whether most trees in the spot are pulpwood (less than 9 inches in diameter) (23 cm) or sawtimber size (more than 9 inches in diameter).
5. If only stage 3 trees are present, control is not necessary.
6. Determine the control priority for the spot, using the guide on the next page (item C).

C. Guide to southern pine beetle control priorities (May through October):

Key to spot growth	Your spot's classification	risk-rating points
A. Stage 1 trees	absent	0
	present	30
B. Stage 1 and 2 trees	1 to 10	0
	11 to 20	10
	21 to 50	20
	more than 50	40
C. Pine basal area (ft^2/a) or stand density at active head or heads	less than 80 (low density)	0
	80 to 120 (medium density)	10
	more than 120 (high density)	20
D. Stand class by average d.b.h. (in inches)	pulpwood (9 inches or less)	0
	sawtimber (more than 9 inches)	10
If total is: 70 to 100.....control priority is: High		Buffer strip width (feet)
If total is: 40 to 60.....control priority is: Medium		40 to 100
If total is: 0 to 30.....control priority is: Low		10 to 40



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Southern Pine Beetle Fact Sheet Number 5

INSECTICIDES FOR THE SOUTHERN PINE BEETLE

The best way to protect your pine trees is to make sure they are not attacked in the first place. Keep them healthy. A wounded, sick, or weakened pine is an invitation to dinner for southern pine beetles.

But what if it is already too late for an ounce of protection? By the time you spot telltale symptoms of beetle attack—pitch tubes, feeding galleries in the inner bark, and fading needles—it is too late to save the tree.

Your only alternative is to stop beetle spread to nearby pines. You can do this in two ways. First, if the beetles are still under or in the bark of the attacked pines, cut the trees down and haul them away or burn them. This should break up the center of beetle emergence and stop them from attacking other trees.

Second, spray the attacked pines with an approved insecticide which will kill eggs, larvae, pupae, and adults still under the bark. Or, you may choose to spray uninfested trees next to the ones under attack to protect them during the period of beetle emergence.

Whichever method of control you choose, act quickly or the beetles will spread to other pines. Check all pines carefully, as successful remedial control depends on treating all infested trees.

Only two insecticides are approved for use against the southern pine beetle: lindane and Dursban (chlorpyrifos). Lindane

is available as a liquid (emulsifiable) concentrate that is diluted with water and applied as a 0.5 percent solution. Lindane concentrates are sold in various strengths, so follow the mixing directions on the container label. This insecticide has a proven track record against the southern pine beetle.

Dursban was registered for SPB control in February 1979. It is sold as a liquid concentrate containing 4 pounds of insecticide per gallon of concentrate. The spray is prepared by mixing 2 2/3 fluid ounces of concentrate with water to make 1 gallon (20.8 ml in 1 liter) (equivalent to 2.1 gallons in 100 gallons of water. Dursban is to be applied only by or under the supervision of pest control operators or other trained personnel responsible for insect control programs.

Apply lindane or Dursban by hand- or power-operated ground spray equipment. When protecting uninfested pines, spray only the main trunk up to the upper 1/3 of the crown needles. Do not spray the limbs.

However, when treating attacked pines, cut, limb and buck the infested trees into workable lengths. Spray the entire infested bark surface to the point of runoff to ensure adequate control.

Recommendations for the use of Dursban and its approval by the Environmental Protection Agency for use against the southern pine beetle are based on research conducted through the USDA Expanded Southern Pine Beetle Research and Applications Program.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, fish, and other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.



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Southern Pine Beetle Fact Sheet Number 10

RATING THE SUSCEPTIBILITY OF PINE STANDS TO SOUTHERN PINE BEETLE ATTACK

The southern pine beetle (SPB) occurs in all geographic regions of the South. Studies have shown that high-hazard stands are commonly associated with slow radial growth. Conditions that cause poor growth differ greatly in the Southern Coastal Plain, the Piedmont, and the Southern Appalachian Mountains. Several rating systems have been developed to identify high-hazard stands within these areas. Testing and implementation of the ranking systems have been limited to stand, site, and insect conditions associated with selected areas in the geographic subregions.

The Southern Coastal Plain

Natural stands susceptible to SPB attack in the Coastal Plain are characterized by high stand densities, a large proportion of pine sawtimber, and declining radial growth. Outbreaks occur most frequently in these stands located on poorly drained soils and low-lying areas; trees on dry or droughty soils are less often attacked. Rating systems have been developed for east Texas, the Kisatchie National Forest in Louisiana, corporate timberland in Louisiana, Mississippi and Texas, and forests in southern Arkansas. Details are summarized in the following publications:

Hicks, R.R., Jr.

1980. A simple stand hazard rating system for east Texas. In How to rate susceptibility of pine stands to southern pine beetle. Workshop sponsored by Stephen F. Austin Univ., USDA ESPBRAP, and the Texas For. Serv., Nacogdoches, Tex., March 27, 1980.

Hicks, R.R., Jr., J.L. Howard, K.G. Watterston, and J.E. Coster.

1980. Rating forest stand susceptibility to southern pine beetle in east Texas. *For. Ecol. Manage.* 2:(in press).

Ku, T.T., V.B. Shelburne, and J.M. Sweeney.

1979. Preventing damage from the southern pine beetle through better forest management. Pest leaflet of Univ. of Ark., Monticello, Ark., Ark. For. Comm., and USDA For. Serv., Southeast. Area. Published by Dep. For., Univ. of Ark., Monticello.

Ku, T.T., J.M. Sweeney, and V.B. Shelburne.

1980. Site and stand conditions associated with southern pine beetle outbreaks in Arkansas--a hazard rating system. *South. J. Appl. For.* 4: 125-132.

Kushmaul, R.J., M.D. Cain, C.E. Rowell, and R.L. Porterfield.

1979. Stand and site conditions related to southern pine beetle susceptibility. *For. Sci.* 25: 656-664.

Lorio, P.L., Jr.

1978. Developing stand risk classes for the southern pine beetle. Res. Pap. SO-144. 9 p. USDA For. Serv., South. For. Exp. Stn., New Orleans, La.

Mason, G.N.

1980. Hazard verification and implementation through aerial photo stand mapping. In How to rate susceptibility of pine stands to southern pine beetle. Workshop sponsored by Stephen F. Austin State Univ., USDA ESPBRAP, and Tex. For. Serv., Nacogdoches, Tex., March 27, 1980.

The Piedmont

Natural stands susceptible to endemic SPB attack in the Piedmont are characterized by well-stocked pine stands with a large percentage in shortleaf pine, slow radial growth during the most recent 10 years, and a high clay content in the surface and subsurface horizons. Two systems have been developed for ranking the susceptibility of natural stands to SPB attack in the upper Piedmont of Georgia. The first is a predictive equation that includes variables easily measured or often contained in existing inventories; the second is designed for use in the field by service foresters. Piedmont conditions are described in the following pest leaflet.

Belanger, R.P., and T.S. Price.

1979. The susceptible forest in the upper Piedmont. Pest leaflet of Ga. For. Comm., Macon, Ga., and USDA For. Serv., Southeast. For. Exp. Stn., Asheville, N.C.

The Southern Appalachians

Studies of stands in the mountains of Georgia, North Carolina, South Carolina, and Tennessee have shown that those severely attacked by the southern pine beetle were densely stocked, slow growing, and had a large proportion of overmature pine sawtimber. Shortleaf pine and pitch pine were more susceptible to beetle attack than Virginia pine and eastern white pine. Systems are be-

ing developed to rank the susceptibility of natural stands in the mountains. See the following publication for additional details.

Belanger, R.P., E.A. Osgood, and G.E. Hatchell

1979. Stand, soil, and site characteristics associated with southern pine beetle infestations in the southern Appalachians. Res. Pap. SE-198. 7 p. USDA For. Serv., Southeast. For. Exp. Stn. Asheville, N.C.

For further information, contact your State forestry agency or:

USDA Forest Service, Southeastern Area
Forest Pest Management Staff
2500 Shreveport Highway
Pineville, La. 71360
Telephone (318) 473-7280

OR

USDA Forest Service, Southeastern Area
Forest Pest Management Staff
P.O. Box 5895
Asheville, N.C. 28803
Telephone (704) 258-2859, extension 625

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Southern Pine Beetle Fact Sheet Number 15

SALVAGE REMOVAL¹

Managers and owners usually prefer salvage removal over the other control options because infested trees are removed from the forest and used, giving the landowner some financial return. However, salvage of individual spots is not always possible because of inaccessibility, insufficient volume, poor lumber or pulpwood market, and sensitive environmental constraints. Additionally, salvage removal often takes longer to implement than alternative tactics.

For effective salvage, material infested by the southern pine beetle (SPB) must be removed on a timely basis. An adequate buffer strip of uninfested green trees must also be cut around the spreading edges of the spot. Doing this ensures the removal of freshly attacked pines that were overlooked or became infested after the spot was first ground-checked and marked.

When to Act

Suppression should be a year-round effort made from late spring through fall to control actively spreading infestations. Winter and early spring treatment is also important because it will reduce the potential for spot growth or new spot development later in the spring and summer. Although infestations are concentrated in fewer trees for longer periods of time during the colder months, the spots are harder to detect from the air.

¹ See Southern Pine Beetle Fact Sheet No. 3
Setting control priorities for the southern pine beetle.

Procedures for Salvage Removal

1. Identify the spreading head(s) of the spot. The head(s) contain the trees that have been recently attacked. They may have green or fading foliage, fresh pitch tubes, boring dust in bark crevices or on the foliage of the understory vegetation, tight bark, and adult checkered beetles on the bark.
2. Mark all SPB-infested trees or a boundary around them if there are many trees.
3. If recently attacked trees are present, mark a horseshoe-shaped buffer strip of green uninfested trees around the head(s). The buffer should surround the recently attacked ones. A strip 40 to 70 feet wide (12.1 to 21.3 m) will be needed for most active spots, while a 100-foot (30.4 m) strip (and occasionally larger) may be needed for large, rapidly expanding spots. As a rule, the width of the buffer should not exceed the average height of the trees in the spot. When a spot has 10 or fewer infested trees, none of which are freshly attacked, it usually should not be treated.
4. Salvage removal of infested and bufferstrip trees should begin as soon as possible after ground checking and marking the spot. Vacated trees (without beetles) can be left standing because their removal will not contribute to beetle control. But they can be salvaged if they have not deteriorated and the additional volume is needed to make the salvage removal economically feasible. Choosing which trees to salvage first depends on the season. The following priorities, in order of importance, should be followed in salvage removal:

May–October

- a) Trees in the buffer zone
- b) Trees with fresh attacks
- c) Remaining trees with living brood
- d) Vacated trees

November–April

- a) Remaining trees with living brood
- b) Trees with fresh attacks
- c) Trees in the buffer zone
- d) Vacated trees

5. Infested trees should not be decked next to green timber because emerging beetles may attack adjacent green trees.

6. Check salvaged spot for breakouts² during the next aerial survey. Treat breakouts as needed.

Other Options

The landowner's management objectives affect the choice of one or several treatment methods. Recommended treatment methods not discussed in this fact sheet include cut-and-leave, chemical control, and pile-and-burn. SPB Fact Sheets 16, 17, and 18 discuss these three methods, respectively.

This fact sheet is based on information in Agricultural Handbook Number 575, Direct Control Methods for the Southern Pine Beetle, by Kenneth Swain, Sr., USDA Forest Service and Michael Remion, South Carolina State Commission of Forestry. The handbook will be published in 1981.

2 When SPB emerging from a treated spot attack neighboring trees, this new infestation is known as a breakout.

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Southern Pine Beetle Fact Sheet Number 16

CUT-AND-LEAVE¹

The cut-and-leave method was first recommended by the Texas Forest Service for controlling small spots (10 to 50 infested trees) that could not be salvaged. This technique involves felling infested trees and a buffer of uninfested trees and leaving them in the woods. The treatment disrupts spot growth and causes emerging adult southern pine beetles (SPB) to disperse into the surrounding forest. Spots should be treated only if they contain trees with fresh attacks. The method has been primarily used in the gulf coast States.

Cut-and-leave is practical, relatively inexpensive, and requires a minimum of manpower, equipment, and training. The procedure can be applied soon after spots are detected. The major disadvantage is that a buffer strip of green uninfested trees must be felled around each spot to assure that newly attacked trees, which favor spot growth, are included in the treatment. If salvage becomes feasible at a later date, the felled trees can be removed. Larger spots (51 to 150 trees) can be treated using the cut-and-leave method if the spots will eventually be salvaged.

Procedures for Cut-and-Leave

1. Select spots with 10 to 50 infested trees. Some may have fresh attacks. Higher priority

spots, those with a high proportion of newly attacked trees, should be treated first. Spots with more than 50 infested trees can be treated if they are to be salvaged later.

2. Mark and fell SPB-infested trees toward the center of the spot.
3. Mark and fell a horseshoe-shaped buffer strip of green uninfested trees around those with fresh attacks. Fell them toward the center of the spot. In small spots, the buffer may encircle the spot. However, the buffer should be no wider than the average height of the trees in the spot.
4. Dead trees from which all SPB have emerged need not be felled. Leaving these trees will allow the beetle's natural enemies to complete their development and emerge. Such trees also provide den sites for certain woodpecker species.

5. Check cut-and-leave spots for breakouts² during the next aerial survey. Treat breakouts as needed.

When to Act

Cut-and-leave should be used during the period when SPB spots are expanding (approximately May to October).

Other Options

The landowner's management objectives affect the choice of one or several treatment methods. Recommended treatment methods not discussed in this fact sheet include salvage removal, chemical

¹ See Southern Pine Beetle Fact Sheet No. 3
Setting Control Priorities for the southern pine beetle.

² When SPB emerging from a treated spot attack neighboring trees, this new infestation is known as a breakout.





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Southern Pine Beetle Fact Sheet Number 17

CHEMICAL CONTROL¹

Insecticides effectively control the southern pine beetle (SPB) in individual trees or small groups of trees. Registered insecticides are available for killing beetles in trees that have been attacked and for preventing attacks on green trees. Although chemical control is costly and subject to environmental constraints, it may be the best alternative in urban forests or high-value recreational areas, and even in limited areas of commercial forests when other methods cannot be used.

The landowner may choose to protect selected high-value trees from attack by applying a preventive spray. Technically, this is not a direct control tactic, but it does prevent attacks and reduce tree mortality in special-use or high-value situations. For short trees, field crews can apply insecticidal sprays with a hydraulic sprayer. Treatment of taller trees usually requires special equipment.

People considering chemical control should contact a local State forestry office, county extension agent, or USDA Forest Service, Forest Pest Management office for the latest information on registered insecticides and their use. Always follow label instructions on the insecticide container.

Procedures for Chemical Control

The following procedures are recommended whenever insecticides are used:

1. Identify and mark all infested trees. Do not mark a buffer strip or vacated trees.
2. Trees containing advanced broods (late larvae, pupae, adults) should be treated first.
3. Infested trees should be felled, limbed, and cut into workable lengths. In large spots, infested trees should be cut into workable lengths and sprayed as they are felled to ensure complete treatment.
4. Use low-pressure sprayers--hydraulic for large, accessible spots, garden or backpack type for small or inaccessible spots.
5. Spray the entire infested bark surface to the point of runoff. To accomplish this, adjust nozzles so the spray stream is about equal to the tree diameter when the nozzle is held about 1 foot (30.5 cm) from the bark surface. It may be necessary to turn large logs several times to get complete coverage.
6. Trees should not be sprayed when the bark is wet.
7. Do not spray vacated trees. Spraying such trees serves no useful purpose and, in fact, may kill some of the beetle's natural enemies that are completing their development in these trees. Also, do not spray stumps of infested trees that have been felled.
8. After completing treatment, field crews should check around the spot to see that no infested trees have been overlooked.
9. Check for breakouts during the next aerial survey. Treat breakouts² as needed.

¹ See Southern Pine Beetle Fact Sheet No. 3 Setting control priorities for the southern pine beetle.

² When SPB emerging from a treated spot attack neighboring trees, this new infestation is known as a breakout.

When to Act

Suppression should be a year-round effort made from late spring through fall to control actively spreading infestations. Winter and early spring treatment is also important because it will reduce the potential for spot growth or new spot development later in the spring and summer. Although infestations are concentrated in fewer trees for longer periods of time during the colder months, the spots are harder to detect from the air.

Other Options

The landowner's management objectives will affect the choice of one or several treatment methods. Recommended treatment methods not discussed in this fact sheet include salvage removal, cut-and-leave, and pile-and burn. SPB Fact Sheets 15, 16, and 18 discuss these three methods, respectively.

This fact sheet is based on information in Agricultural Handbook Number 575, **Direct Control Methods for the Southern Pine Beetle**, by Kenneth Swain, Sr., USDA Forest Service and Michael Remion, South Carolina State Commission of Forestry. The handbook will be published in 1981.

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Southern Pine Beetle Fact Sheet Number 18

PILE-AND-BURN¹

Felling, piling, and burning infested trees is one of the oldest control methods for the southern pine beetle (SPB) and is effective when properly done. But because of high costs and environmental constraints, the practice has been used sparingly in recent years. All the bark must be completely burned to achieve control. It is not necessary to cut, pile, and burn vacated trees. For practical reasons, infested and vacated trees are usually piled and burned to clear the site for regeneration. Burning can cause wildfires, so it should be restricted to periods of low fire danger. Also, Federal and State air pollution laws must be taken into consideration.

Procedures for Piling-and-Burning

1. Identify and mark all SPB-infested trees.
2. Fell all infested trees and pile them in the center of the infested area.
3. Burn the pile until all infested bark has been thoroughly charred.
4. Do not burn if it cannot be done safely or if it will promote significant soil erosion.
5. Check carefully around the spot to ensure that no green infested trees have been overlooked.

6. Check for breakouts during the next aerial survey. Treat breakouts² as needed.

When to Act

Suppression should be a year-round effort made from late spring through fall to control actively spreading infestations. Winter and early spring treatment is also important because it will reduce the potential for spot growth or new spot development later in the spring and summer. Although infestations are concentrated in fewer trees for longer periods of time during the colder months, the spots are harder to detect from the air.

Other Options

The landowner's management objectives will affect the choice of one or several treatment methods. Recommended treatment methods not discussed in this fact sheet include salvage removal, cut-and-leave, and chemical control. SPB Fact Sheets 15, 16, and 17 discuss these three methods, respectively.

This fact is based on information in Agricultural Handbook Number 575, Direct Control Methods for the Southern Pine Beetle, by Kenneth Swain, Sr., USDA Forest Service and Michael Remión, South Carolina State Commission of Forestry. The handbook will be published in 1981.

¹ See Southern Pine Beetle Fact Sheet No. 3 Setting control priorities for the southern pine beetle.

² When SPB emerging from a treated spot attack neighboring trees, this new infestation is known as a breakout.

